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Brucellosis

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From the standpoint of public health

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BRUCELLOSIS is not only of concern to the veterinarian from the standpoint of animal health; it also concerns the Veterinary Profession from the standpoint of public health. In dealing with brucellosis in animals, the veterinarian must be ever on his guard—lest he himself become infected with the serious malady commonly termed undulant or malta fever. From the standpoint of public health, chief reliance is placed on members of the Veterinary Profession in the pursuit of measures for the control and eradication of brucellosis in cattle, swine and other susceptible animals.

Etiology

Brucellosis is primarily a disease of animals manifested chiefly in cattle, swine, sheep and goats. The etiological microorganisms are allocated as follows: *Brucella abortus,* the bovine strain, with the source in cattle; *Br. suis,* the porcine strain, with the source in swine; *Br. melitensis,* the caprine strain, with the source in sheep and goats. The three species of Brucella are transmissible to human beings, giving rise to brucellosis of man, commonly called undulant or malta fever. Man may contract brucellosis through the use of raw dairy products from infected dairy cows, or through direct contact with infected animals. It is of interest to note that when human illness follows direct contact with infected animals, their tissues or discharges, brucella organisms usually enter the body through the skin. Veterinarians, as a group, in their dealings with problems of sterility and obstetrics, are therefore exposed to infection by direct contact to a very marked degree. That infection by direct contact as a major mode of infection is evidenced by the relatively high incidence of brucellosis among packing house workers. The veterinarian should, therefore, put forth every precaution to prevent direct contact when dealing with the livestock population.

Although brucellosis of man has been reported in each of the 48 states, the incidence is relatively low. A nationwide survey in the United States during the period 1930-43, as reported by State Departments of Health, indicate the annual rate of incidence to vary from a low of 0.3 persons per 100,000 population in Nebraska, to a high of 7.8 persons pere 100,000 population in the State of Vermont. The annual incidence in Iowa during the same period was 5.8 persons per 100,000 population. Of the cases of human brucellosis reported to State Departments of Health, it is of interest to note the relationship of age and sex to the incidence of the disease. Table I (page 81) indicates the percentage distribution by age and sex of 1808 cases as reported by Iowa physicians.

Occurrence

It is of interest to note that in the first decade of life, females suffer from this disease quite as frequently as males. This statement applies also to persons 70 years of age and over. Raw dairy products from infected cows account for a high percentage of cases at extremes of life. However, the preponderance of cases among males of teen-age and through the decades of

TABLE I

THE PERCENTAGE DISTRIBUTION BY AGE AND SEX AS REPORTED BY IOWA PHYSICIANS

Age Group	Total Cases	Male	Female	Per Cent in Age Groups	
				Male	Female
1–9	58	27	31	46.5	53.5
10–19	163	121	42	74.2	25.8
20–29	495	414	81	83.6	16.4
30–39	497	411	86	82.7	17.3
40–49	319	254	65	79.6	20.5
50–59	172	124	48	72.4	27.9
60–69	76	50	26	65.8	34.2
70+	28	16	12	57.1	42.9
Total, all ages	1,808	1,417	391	78.4	21.6

active adult life, emphasizes the major part played by direct contact in accounting for the difference in attack rate in the two sexes. Among brucellosis patients of all ages, nearly 80 per cent are males, a little over 20 per cent are females. It is also of interest to study the relation of occupation in regard to the mode of transmission of the brucella organism. In a report by the Iowa State Department of Health, based on 1564 case reports completed by Iowa physicians for the period 1936 to 1941, the following data has been compiled in Table II.

Occupational Variation

Attention is directed to the column at the extreme right of the table, which shows the calculated average annual morbidity rate per 100,000 population in various occupational groups. It will be noted that the hazard of exposure to brucella infection is greatest in the group of packing house employees. The hazard is second greatest among male farm workers with a far smaller relative hazard among children, housewives and merchant-professional groups. Among the 118 packing house workers who acquired brucellosis during the 6 year period, 1836 to 1941, 98 per cent gave the history of direct contact with livestock; only 20 per cent of this group used raw dairy products during the period preceding onset of illness. The importance of brucella infection of swine is emphasized in a study reported by McNutt[1], who tested 1547 swine by the rapid agglutination method and reported that 3 per cent of all animals slaughtered at packing houses showed a positive agglutination reaction of 1:25 or above, and 2.3 per cent in titers of 1:50 or higher. McNutt succeeded in isolating the porcine species of brucella (*Brucella suis*) from 41 per cent of 34 reacting animals, organs of which were cultured bacteriologically. In the above studies, no specific data were compiled in regard to incidence among veterinarians. However, in observing the relatively high rate of incidence among packing house employees and male farm workers, it is evident that incidence from direct contact with infected animals constitutes a major mode of transmission. The veterinarian may well be placed in this category of individuals subject to infection by direct contact, especially the sterility worker and the obstetrician. It must also be kept in mind that data compiled in the above tables constitutes only those cases observed and reported by Iowa physicians. It may be safely speculated that a relatively large number of cases exist each year that go unobserved and hence unreported by physicians due to the nature of the disease. In reviewing case reports completed by Iowa physicians the Iowa State Department of Health reports that the 10 most distressing symptoms in the order of frequency are: fever, chills, sweating, weakness, malaise, headache, muscular or joint pains, backache, anorexia, and loss of weight. Hence many individuals contracting brucellosis are prone to attribute their condition to such factors as poor teeth, sinusitis, overheating; espe-

cially when the chronic lymphogranulomatous type of bruecllosis exists which runs a prolonged course.

Brucellosis is not a highly fatal disease, as mortality does not usually exceed 2 per cent or 3 per cent of morbidity. Duration of illness varies from a month to three months in about 70 per cent of the cases. Approximately 15 per cent of the patients have symptoms for 6 months or longer. Percentages are based on follow-up reports supplied through courtesy of attending physicians in Iowa. Forbus describes pathological findings to exist in different types of the disease, and conveniently classifies brucellosis into three categories which may be briefly outlined as follows: (1) the septicemic, acute form; (2) the focal or localized, subacute form; and (3) the chronic lymphogranulomatous type with a prolonged course. The septicemic cases show very little that is specific for brucella infection; the findings are those of almost any bacteremia with profound intoxication. On the other hand, the subacute type, manifested by local infections, sometimes cause vegetative endocarditis, meningitis, orchitis, osteitis and subacute arthritis. Forbus reports that the lymphogranulomatous form of brucellosis is the most chronic type where he describes gross and microscopic lesions in lymph nodes, spleen, liver, kidney and bone marrow. To determine whether or not a latent, subclinical brucella infection existed, agglutination and skin test surveys were carried out in communities during epidemic and sporadic occurrence of brucellosis to determine if a latent, subclinical, brucella infection existed. Studies revealed that for each clinical case, a number of persons who had been exposed to the same source of brucella infection showed positive agglutination in diagnostic dilution. Positive skin reaction to brucellergen and at times a positive blood culture, all with entire absence of clinical manifestations. Thus we may conclude that a latent, subclinical manifestation of brucellosis does exist that may become clinical under suitable conditions.

TABLE II

THE RELATIONSHIP OF OCCUPATION IN REGARD TO THE MODE OF TRANSMISSION OF THE BRUCELLA ORGANISM

Occupation	Area	Per Cent Contact With Animals	Per Cent Using Raw Milk	Cases 1936–1941	Population in Group	Average Annual Morbidity Rate per 100,000 Population
Child	Rural	60	85	47	1,454,037	0.5
Farm wife	Rural	40	100	81	1,454,037	0.9
Farm worker	Rural	100	100	320	411,776	17.1
Child and teen-age	Urban	23	77	26	1,084,231	0.4
Housewife	Urban	3	92	36	1,084,231	0.6
Merchant-professional group	Urban	25	84	154	1,621,500	1.6
Packing house worker	Urban	98	20	118	15,000	131.1
Total				782	2,538,263	5.1

Brucella Strains

It is of interest to note the species of the brucella organism that are commonly encountered. The following table shows the number and percentage of brucella strains as isolated from blood cultures and other human and animal sources, at the Iowa State Hygienic Laboratory, from September, 1927, to May 10, 1944.

Several laboratory procedures have been devised as aids in diagnosis. Of the various laboratory procedures, the blood culture method undoubtedly rates first place, although it is not always possible to obtain a blood culture. However, isolation of Brucella from the blood confirms the

clinical diagnosis. It leads to identification of the species or type of organism which is of inestimable value in tracing of infection to its source in the hog, cow or goat.

Diagnosis

The agglutination test probably rates second in importance to blood culture. Both rapid and slow methods of agglutination are trustworthy. However, when these tests are negative at first, agglutination tests should be repeated. A negative test does not exclude the disease.

Special cultures and guinea pig inoculations are of special value in many cases. Brucella may be isolated and identified after special culture, or by guinea pig inoculation with blood, exudates, urine, bile, feces, tissues, organs, or with suspected food products such as raw milk.

The skin test is of value in certain cases. A positive intradermal test does not mean that the symptoms from which the patient is suffering at the time are necessarily due to brucellosis. On the other hand, a positive test, like the tuberculin reaction, indicates infection acquired recently or at some time in the past.

Although the opsonocytophagic test has been devised and used to some extent, results may be interpreted with caution.

Brucellosis, as a livestock menace and public health problem, has placed an additional responsibility upon the Veterinary Medical profession and Livestock Sanitarians. Here indeed lies a challenge to the Veterinary Medical profession in the field of public health. The Bureau of Animal Industry of the United States Department of Agriculture has released recent data relative to two important measures. These measures pertain (1) to the agglutination test with elimination of reacting animal, and (2) active immunization of calves when 4 to 6 months old (calfhood vaccination), using as antigen an attenuated, viable strain, strain 19, of *Br. abortus*. The following data have been released by the Bureau of Animal Industry of the United States Department of Agriculture:

A. Cattle

1. Testing in the U.S.S. (July, 1934-March, 1944)
   - Total agglutination tests 63,736,108
   - Infected animals eliminated.... 2,704,553
   - Total accredited herds 41,140
   - Total accredited counties 582
   - Accredited states (North Carolina) 1
2. Vaccination in the U. S. A.
   - Calves vaccinated 375,000
   - Herds involved 41,000

B. Hogs

1. Research studies in Swine Brucellosis are being conducted by the U. S. Dept. of Agriculture and in the following states, cooperating: Michigan, Indiana, Minnesota, Iowa, California.

TABLE III

THE NUMBER AND PERCENTAGE OF BRUCELLA STRAINS AS ISOLATED FROM BLOOD CULTURES AND OTHER HUMAN AND ANIMAL SOURCES

Specimen	Suis	Abortus	Melitensis	Total
Blood culture	169 (70.7%)	65 (27.3%)	5 (2.0%)	239
Urine	3	0	0	3
Spinal fluid	2	0	0	2
Osteomyelitis	2	0	0	2
Spondylitis	0	1	0	1
Cervical Adenitis	1	0	0	1
Pleural fluid	1	0	0	1
Feces	1	0	0	1
Cow's milk, cream	5*	66	0	71
Calf fetus	0	1	0	1
Hog joint	1	0	0	1

* One strain isolated from improperly pasteurized milk, four strains from three epidemics of porcine brucellosis transmitted by raw milk.

2. In hog raising states, these animals are very frequently the source of human infection, emphasizing the necessity of applying the agglutination test to swine and the need for segregation or slaughter of reacting animals.

C. Goats-Sheep

1. Control measures stressed by Ward Giltner include: Prevention of interstate shipment of infected goats, agglutination testing, isolation and proper disposal of infected animals.

D. Other Animals

1. Horses, dogs and chickens are susceptible but play a relatively minor part in the transmission of brucellosis.

Treatment

Rational treatment of human brucellosis based on present day knowledge may be summarized briefiy as follows:

(1) Complete rest, preferably in bed, tends to shorten the duration and may avoid recurrence of illness. (2) Attention should be given to relief of symptoms, to a nutritive diet and to other supportive measures. (3) Specific therapy using such agents as Brucellin, brucella vaccine, type-specific convalescent serum, and antiserum. (4) Non-specific therapy where typhoid vaccine may be employed. (5) Chemotherapy (a) Acriflavine; mercurochrome (5 cc. of 1 per cent solution given intravenously); metaphen, and other germicides have been used with varying results; (b) Sulfonamide drugs, alone or in combination with specific or non-specific therapy have been used. While some have reported satisfactory results from sulfatherapy, other physicians regard such treatment as useless. Sulfa drugs have been reported ineffective in animal studies and prolonged use may prove harmful. (c) Penicillin is considered ineffective against brucella organisms, but might prove life saving against secondary bacterial invaders.

Prevention

Careful pasteurization of all dairy products is an essential safeguard against milk borne cases and epidemics of brucellosis of man. Since contact with infected animals probably accounts for most cases of brucellosis or undulant fever on farms and for practically all the cases among packing house workers, special precautions are needed to reduce the hazard of direct contact to a minimum. Veterinarians in their dealings with livestock should employ every precaution to prevent infection. This would indicate the use of rubber gloves preferably of full arm length for the sterility worker or obstetrician—followed by immediate use of antiseptic solutions on exposed skin. Carrying out of control and preventive measures against brucellosis is dependent upon financial support of federal and state agencies, and upon cooperative efforts of members of the Veterinary Medical and Medical professions.

[1] McNutt, Veterinary Research Institute, Ames, Iowa.

The statistics of slaughter of animals under federal inspection for the first half of 1944 showed the cattle kill to be 6,171,190, an increase of about 1,200,000 head over a year ago. The hog slaughter was 41,411,972 head, compared with 29,897,285 a year ago, the previous all-time high. Sheep and lambs slaughtered were 9,866,795 head, or nearly 500,000 above a year ago. All of these result in a new all-time high to be reached in their respective groups.

The cause of pendulous crop is not known, but it is frequently associated with excessive fiber in the ration causing partial or complete gizzard impaction. Excessive water in hot weather may be responsible for it.

A diet of 22-26 per cent protein is recommended in starting young turkeys. This is continued until the poults are eight weeks of age. Then the protein may be reduced to 18 per cent by addition of grain to the ration.